Cyclical Output, Cyclical Unemployment, and augmented Okun's Law in MENA zone

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Abstract

In this paper we investigate the relationship between economic growth and unemployment in MENA zone (six Arab countries: Tunisia, Egypt, Morocco, Lebanon, Jordan, and Oman) through the implementation of Okun's Law using quarterly dataset covering the time period 2000 :1- 2014 :4. Static and Dynamic linear models are used to test the linkage between cyclical unemployment and cyclical growth rate. The empirical results from all these models do not indicate robust evidence but it confirm an inverse linkage between unemployment rate and economic growth, as the Okun's Law suggests (except for Oman). Initially, the static linear model, the static asymmetric model, and the dynamic linear models (ARDL) **fail to explain** the long run tradeoff between unemployment and output due to severe model misspecifications. Most of these results are in line with previous studies ((Moosa I. A., 2008), (Kreishan, 2011), (Andari & Bouaziz, 2015)), and (Al-hosban, 2017). In an NARDL gap specification, the Okun's coefficients are the asymmetric long run parameters. Okun's coefficients are statistically significant, which means that output growth can be translated into employment gains. Absolute effect of an economic **contraction** is significantly **larger** than that of an expansion in Tunisia, Egypt, Morocco, and Libanon. The opposite is true for **Jordan and Oman**. An economic **upturn** of 3.37%, 2.98%, and 2.5% respectively in **Tunisia,** Morocco, and Egypt reduces unemployment by 1%, while the **downturn** of 5.03%, 2.43% (and about 12%) respectively in **Tunisia,** Morocco (and **Lebanon and Jordan)** achieves the opposite. Empirical finding provides then an additional proof that Okun's law could exist in a developing countries such as Tunisia, Egypt, Morocco, Lebanon, and Jordan.

Keywords : MENA zone, Okun's Law, Gap model, Asymmetric Cointegrating Relationships, Asymmetric Dynamic Multipliers, ARDL ECM-based Estimation and Tests, Nonlinear Unemployment-Output Relationship.

JEL Codes: C22, E32, J64, E24.

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I. Introduction

Unemployment has been recognised as a major problem in Arab countries, particularly non-oil producing ones. Unemployment rates in the Middle East and North Africa (MENA) region, which encompasses the Arab world, are among the highest in the world. This can be attributed to the lack of sufficient structural reforms in the labour market of this region. The correlation between unemployment and output has been explored intensively in literature. The remarkable theory is the Okun's law, which essentially proposes a negative relationship between the unemployment and real output (Okun A. M., 1962).[2] Okun's law estimate Okun's coefficient, which is a measure of the responsiveness of unemployment to output growth.[3] More specifically, he demonstrates that an increase in the economic growth rate by 3% above the potential rate of growth is expected to reduce the unemployment rate by 1% point for US economy. If Okun's law is valid for a country, it will provide an idea about the kind of unemployment prevailing in this countrie (cyclical or otherwise).[4] This would then imply whether or not unemployment can be reduced by boosting growth.

Several economists have followed (Okun A. M., 1962) by testing the relation between unemployment and output to obtain estimates for Okun's coefficient. A vast number of studies investigate the unemployment-output relationship in a linear framework and assume that the cyclical upturns and downturns have symmetrical effects on unemployment ((Gordon, 1984), (Hamanda & Kurosaka, 1984), (Clark, 1989), (Prachowny, 1993), (Weber, 1995), (Moosa I. A., 1997) (Moosa I. A., 1999), (Cuaresma, 2003), (Silvapulle, Moosa, & Silvapulle, 2004), (Christopoulos, 2004), (Gabrisch & Buscher , 2006), (Moosa I. A., 2008), and (Ahmed & Awadalbari, 2014)).[5] These studies generally provide estimates of Okun's coefficient, which vary substantially across countries and over time. The empirical estimates of Okun's coefficient are sensitive to model specification. When the fitness and stability of the Okun's law have been revisited and discussed by (Sögner & Stiassny, 2002) and (Perman & Tavera, 2005), there is little evidence showing that the labour market should react to the business cycle in the symmetric pattern. In response to this issue, researchers shift their interests into the **nonlinear modeling** of the unemployment-output tradeoff ((Lee, 2000), (Harris & Silverstone , 2001), (Sögner & Stiassny, 2002), , (Cuaresma, 2003), (Vougas, 2003), (Silvapulle, Moosa, & Silvapulle, 2004), (Huang H. C. & Chang , 2005), (Huang & Lin, 2006), (Marinkov & Geldenhuys, 2007), (Fouquau, 2008), (Beaton, 2010), (Jardin & Stephan, 2010), (Shin, Yu, & Greenwood-Nimmo, 2014),) and (Gouider, Nouira, & Sboui, 2018), etc).[6]

The literature on unemployment in the MENA region reflects mixed views about the proposition that growth has failed to deliver jobs. (Keller & Nabil, 2002) suggest that economic

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[2] It relates the level of activities in the labour market to the level of activities in the goods market over the economic cycle.

[3] (Okun A. M., 1970) suggest two type of model specification for Okun's Law and then two models are used for measuring Okun's coefficient: the gap model and the first-difference model.

[4] It is often used as a benchmark for measuring the cost of unemployment in terms of output. It has implications for macroeconomic policy, particularly in determining the optimal or desirable growth rate, and as a prescription for reducing unemployment.

[5] Validity of Okan's law for Sudan is prouved in (Ahmed & Awadalbari, 2014) over the period 1981-2013. Okun coefficient is equal to -0.736910.

[6] For more details, see Table B 1 for breif empirical review given in.Appendice.

growth in the MENA region has been insufficient compared to the region's labour force and that high growth does not guarantee good labour market outcomes. They also point out that employment has strongly expanded despite low levels of growth since public sector employment has been used as a refuge for large portions of the labour force. (Gardner, 2003) addresses the issue of whether or not current GDP growth in MENA countries generates adequate employment or that higher GDP growth is required. In its World Development Report (Bank, 2007), high unemployment is viewed as a reflection of lower-than-average growth rates (among developing countries) and schooling systems that do not impart market-relevant skills and learning. Another view put forward by the World Bank is that labour markets in MENA countries protect the rights of incumbents, making it hard for new entrants to find jobs. (Moosa I. A., 2008) conclude with a dynamic ARDL model that in four Arab countries: **Algeria, Egypt, Morocco and Tunisia**, output growth does not translate into employment gains and then boosting growth is not a sufficient condition for reducing unemployment in Arab countries. (Kreishan, 2011)'s empirical results reveal that Okun's law cannot be confirmed for **Jordan**. (Andari & Bouaziz, 2015) found that Okun's law holds for the **Tunisian** with an ECM specification and an Okun's coefficient less than required. (Gouider, Nouira, & Sboui, 2018) conclude, with non linear model, that unemployment is more sensitive to cyclical downturns for the **tunisian** case. Since the long run and short run unemployment-output tradeoff can be asymmetric, structural reforms should be carried out in light of the nature of the unemployment-output relationship. Consequently, identifying the correct inherent characteristics of the unemployment-output tradeoff along the whole time horizon is crucial to determine the optimal structural reforms. This paper looks forward to make some improvements in these issues by focusing on the MENA case which has received to this date little attention.

In MENA region specifically (6 countries : Tunisia, Egypt, Morocco, Lebanon, Jordan, and Oman), growth slowdowns coincide with rising unemployment, and *vice versa,* see Figure 1. This means that, increase in unemployment causes decrease in GDP. Thus reducing unemployment suggests that the rate of GDP growth must be above the growth rate of potential output. This implies that GDP growth must be equal to its possible growth just to keep the level of unemployment rate in parity.This negative correlation between GDP growth ($Y_{cyc,t}$) and unemployment growth ($U_{cyc,t}$) has been named "Okun's law," after the economist Arthur Okun who first documented it in the early 1960s.

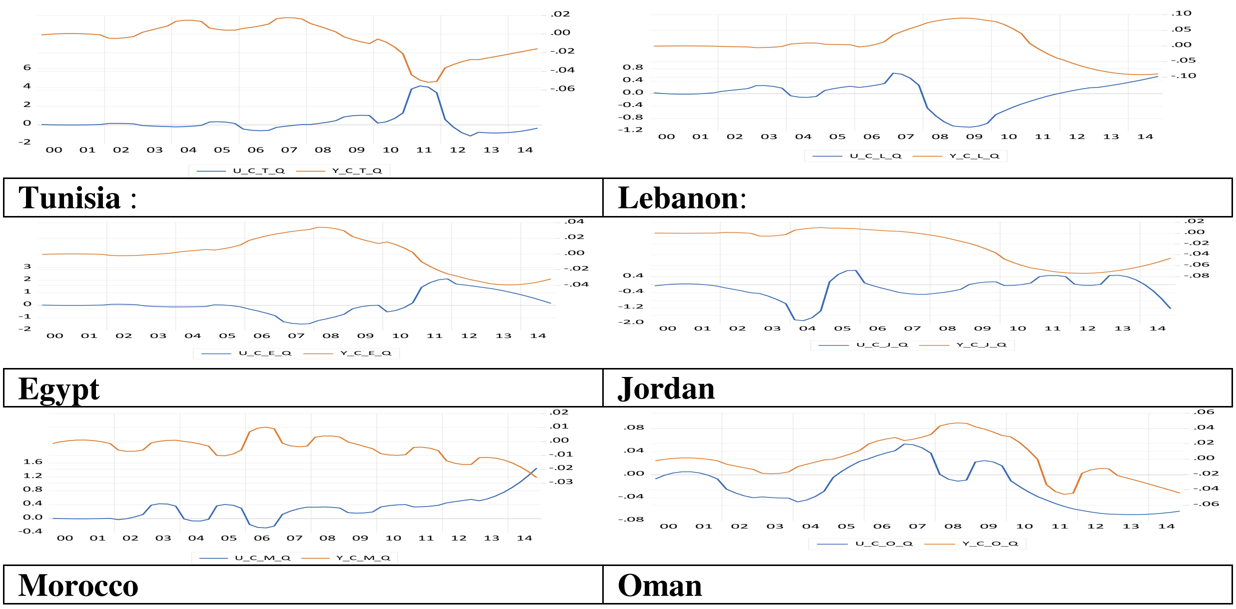

Figure 1 : Time series evolutions: unemployment $U_{cyc,t}$ (blue line) and $Y_{cyc,t}$ $(red\ line)$.

The first objective of this paper is then to estimate Okun's coefficient, and explore the validity of Okun's law, for six Arab countries from MENA zone.[7] The second objective is to analyze the asymmetries of the unemployment-output tradeoff in this erea.This allows us to observe the impacts of positive and negative output shocks separately. Concerning the research method, the nonlinear autoregressive distributed lag (NARDL) model will be utilized since it is competent and effective to test both the long run and short run asymmetries, irrespective of the integration order of considered variables (Shin, Yu, & Greenwood-Nimmo, 2014). The motivation for doing this work is straightforward. If Okun's law is valid for these countries, this will provide an idea about the kind of unemployment prevailing in these countries and then whether or not current GDP growth generates adequate employment. Analysis and data processing is done through software package Stata 15 and Eviews 10.

This paper is organised as follow. Section I presents the empirical literature on Okun Law and its static and linear limitations. Section II describes the econometric methods [NARDL representation, bound testing long run relationship (non linear and asymmetric cointegration test), wald test for long run and short run symmetric, and dynamic multiplier]. Section III summaries the results of unemployment-output tradeoff based on the linear and nonlinear framework after a brief discussions of dataset. Finally, last section concludes the paper.

II. Methodology

The Okun's law has been the focus of a large body of literature as it has implications for macroeconomic policy, particularly in determining the optimal or desirable growth rate, and as a prescription for reducing unemployment.

1. Static specifications : Okun's Law

Two major specifations are considered in the litterature : the first difference model and the gap model. In the first difference model, the output (GDP) and unemployment (U) variables can be expressed in first differences (growth rates). But in the gap model, they are measured in terms of the cyclical components or deviations from long-term trends (see for example, (Lee, 2000)).[8] Following (Lee, 2000), we consider then relation in forms of trend deviations (equation (1)). As a measure for the trend of both real GDP and the unemployment rate we use a (Hodrick & Prescott, 1997) filter.

Okun's Law in the gap model is defined as follow :

$$U_{cyc,t} = \alpha + \beta Y_{cyc,t} + v_t \ (1)$$

where

$$\mathrm{U_{cyc,t}} = (\mathrm{U_t} - \mathrm{U_t^*})$$

[7] The choice was dictated by the availability of data.
[8] The negative relationship between changes in the rate of unemployment and the rate of output growth (Okun's Law) remains one of the most commonly cited stylized facts in modern macroeconomics.

$$\mathrm{Y_{cyc,t}} = \log(\mathrm{GDP_t}) - \log(\mathrm{GDP_t^*}),$$

where $\mathrm{U_{cyc,t}}$ and $\mathrm{Y_{cyc,t}}$ are, respectively, the cyclical components of unemployment and output ($\mathrm{Y_{cyc,t}}$ is the output gap), $\mathrm{U_t^*}$ is the natural rate of unemployment, and $\mathrm{GDP_t^*}$ is the potential output (long run output level), whereas β is the Okun's coefficient. Despite its importance, empirical assessments of Okun's law over the last three decades have been rather disappointing. The majority of this voluminous literature adheres to a linear paradigm, reflecting the assumption that cyclical upturns and downturns have symmetrical effects on unemployment.

(Granger & Yoon, 2002) advance the idea of `**hidden cointegration'**, where cointegrating relationships may be defined between the positive and negative components of the underlying variables. They demonstrate the relevance of this conceptual framework in the context of the linkage between US short- and long-term interest rates and the output-unemployment relationship, both of which are notable for the **lack** of robust evidence of **linear cointegration**. (Schorderet Y. , 2003) generalises this concept and defines the stationary linear combination of the partial sum components. As illustations, (Schorderet Y. , 2003) analyse hidden cointegration between bilateral exchange rates and (Lardic & Mignon, 2008) consider hidden cointegration between the price of oil and GDP. Given the difficulty in interpreting the results of hidden cointegration analysis, (Shin, Yu, & Greenwood-Nimmo, 2014) following (Pesaran, Shin, & Smith, 2001), they generalize the model and consider rather the asymmetric (cointegrating) long-run regression.

The static model (1) is usually weak in investigating the unemployment-output tradeoff since there is no any consideration for **asymmetries**. Most of the existing literature dealing with Okun's law tends to focus on the lack of robustness of the Okun's coefficient, without questioning the linear nature of the relationship.

The **nonlinear** long run asymmetric regression of the unemployment-output tradeoff can then be written as:[9]

$$U_{cyc,t} = \beta^{+}Y^{+}_{cyc,t} + \beta^{-}Y^{-}_{cyc,t} + u_t \quad (2)$$

Where $\mathrm{Y^+_{cyc,t}}$ and $\mathrm{Y^-_{cyc,t}}$ are the partial sum process of the positive and negative changes in $\mathrm{Y_{cyc,t}}$ defined as $\mathrm{Y^+_{cyc,t}} = \sum_{j=1}^{t} \Delta \mathrm{Y^+_{cyc,j}} = \sum_{j=1}^{t} \max(\Delta \mathrm{Y_{cyc,j}}, 0)$, and $\mathrm{Y^-_{cyc,t}} = \sum_{j=1}^{t} \Delta \mathrm{Y^-_{cyc,j}} = \sum_{j=1}^{t} \min(\Delta \mathrm{Y_{cyc,j}}, 0)$, and β^+ and β^- are the related asymmetric long run parameters. If $\mathrm{u_t}$ is stationary, then $\mathrm{U_{cyc,t}}$ and $\mathrm{Y_{cyc,t}}$ are said to be `asymmetrically cointegrated'. Note that standard linear (symmetric) cointegration is a special case of (2), obtained if $\beta^+ = \beta^-$. Symmetry hypothesis can be tested by Wald statistic.

2 Dynamic specifications : Augmented Okun's Law

Selection of the estimation methodology is crucial for times series. The most disturbing fact is non stationarity of the data as it may cause a spurious regression. To avoid this, it is necessary to began by the linear cointegration test (if all variables are I(1)) or non linear cointegration

[9] This approach has been pursued by (Schorderet Y. , 2003) in his analysis of the asymmetric cointegrating relationship between the unemployment rate and output, where output is decomposed as the partial sum processes of positive and negative growth rates.

tests (if either all variables are I(1) or not). Also causalty test (à la Granger for example) can be helpful for adequate specification.[10]

A. Models and notation

a. ECM model

The first method used in this section for the empirical analysis is error correction method (ECM). The ECM is based on stationary data as all the I(1) regressors are in first difference form and includes the lagged residuals of the long run equation, which is also I(0) when the variables have cointegrating relationship. If $U_{cyc,t}$ and $Y_{cyc,t}$ are integrated $I(1)$, the long run cointegration relationship (1) exists when $v_t \sim I(0)$.

One can estimate an ECM using the residual from the long run equation (1):

$$v_t = U_{cyc,t} - (\alpha + \beta Y_{cyc,t}).$$

ECM model can be formulated as the follow :

$$\Delta\, U_{cyc,t} = \lambda v_{t-1} + \sum_{i=1}^{n} \beta_i\, \Delta Y_{cyc,t-i} + \sum_{i=1}^{n} \pi_i\, \Delta U_{cyc,t-i} + \varepsilon_t, \quad (3)$$

where coefficient of adjusment is $\lambda < 0$, and β_i and π_i coefficients measure the short-run dynamics. The speed of adjustment λ is a percentage of the equilibrium error that is corrected in each period.

In this case, the regression equation could be estimated by using the Engel-Granger (E-G) procedure in two step procedure ((Engle & Granger, 1987)Engel and Granger, 1987). The first step is to estimate the long run relationship equation using ordinary least squares (OLS) with variables which are integrated of order I(1) in their levels. In order to avoid spurious regression, Johansen linear cointegration test can be used.[11] The second step of the E-G procedure is to

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[10] The Granger causality test for the case of **two stationary** variables Z_t and X_t, involves as a first step the estimation of the following VAR model:

$$Z_t = a + \sum_i a_i\, Z_{t-i} + \sum_j b_j\, X_{t-j} + \varepsilon_t \text{ (A)}$$
$$X_t = a' + \sum_i a'_i\, Z_{t-i} + \sum_j b'_j\, X_{t-j} + \varepsilon'_t, \text{ (B)}$$

where it is assumed that both ε_t and ε'_t are uncorrelated white-noise error terms. And then set the null and the alternative hypotheses as below :

$$H_0: b_j = 0, \forall\, j$$

(or X_t does not cause Z_t) against

$$H_a: \exists\, b_j \neq 0, \forall\, j$$

(And $H_0: a'_i = 0, \forall\, i$ (or Z_t *does not cause* X_t) against $H_a: \exists\, a'_i \neq 0, \forall\, i$). The hypothesis is tested by using a standard F test. If the computed F value exceeds the F-critical value (or p-value < 5%), we reject the null hypothesis and conclude that X_t cause Z_t. If Z_t and X_t are I(1) , VAR model will be considered in first difference. In this VAR model we can have the following different cases: (1) The lagged X terms in (A) may be statistically different from zero as a group, and the lagged Z terms in (B) not statistically different from zero. In this case we have that X_t causes Z_t. (2) The lagged Z terms in (B) may be statistically different from zero as a group, and the lagged X terms in (A) not statistically different from zero. In this case we have that Z_t causes X_t. (3) Both sets of X and Z lagged terms are statistically different from zero in (A) and (B), so that we have bi-directional causality. (4) Both sets of X and Z lagged terms are not statistically different from zero in (A) and (B), so that X_t is independent of Z_t.

[11] It identify the cointegrating rank of the long term parameters with the Johansen trace and maximum eigenvalue tests.

estimate the corresponding error correction model (3), based on the long run cointegrating relationship to observe the short run dynamics.[12]

When the variables have unit roots, the testing procedure for the identification of causal directions becomes more complex. The null hypothesis, that Y_{cyc} does not Granger-cause U_{cyc} is H_0: $\lambda = \beta_i = 0 \ \forall$ i. This means that there are two sources of causation for U_{cyc}, either through the lagged terms ΔY_{cyc} or through the lagged cointegrating vector. The hypothesis is tested by using a standard F test. The null hypothesis can be rejected if either one or more of these sources affects U_{cyc}. Causality in the long run exists only when the coefficient of the cointegrating parameter λ is statistically significant and different from zero.

b. ARDL model

Equation (1) implies that the relation is contemporaneous, which may not be plausible theoretically. It may also be inadequate empirically owing to the omission of short-run dynamics. Following Hendry et al (1984), the dynamic ARDL model is:

$$U_{cyc,t} = \alpha + \sum_{i=0}^{m} \theta_i \, Y_{cyc,t-i} + \sum_{i=1}^{m} \delta_i \, U_{cyc,t-i} + \varepsilon_t \quad (4)$$

where the contemporaneous (short-run) effect of output on unemployment is measured by the coefficient θ_0, while the long-run effect will be measured by calculating a function of the coefficients, φ, which is given by $\varphi = \frac{\sum_{i=0}^{m}\theta_i}{1-\sum_{i=1}^{m}\delta_i}$. The question that arises here is whether Okun's coefficient is θ_0 or φ. The tendency is to define Okun's coefficient as measuring the long-run effect, as the relation between unemployment and output is not necessarily contemporaneous. Only θ_0 will be reported**.**

For cointegration within ARDL modelling approach, the Bounds Test is the appropriate test. This test was developed by (Pesaran, Shin, & Smith, 2001) and can be applied irrespective of the order of integration of considered variables. The ARDL modelling approach involves estimating in first step the following error correction model:

$$\Delta U_{cyc,t} = \alpha_0 + \alpha_1 U_{cyc,t-1} + \alpha_2 Y_{cyc,t-1} + \sum_{i=1} \beta_i \, \Delta Y_{cyc,t-i} + \sum_{i=1} \pi_i \, \Delta U_{cyc,t-i} + \varepsilon_t.$$

Then, the null hypothesis of no cointegration is

$$H_0: \alpha_1 = \alpha_2 = 0$$

and the alternative hypothesis of cointegration is H_1: $\alpha_1 \neq 0$ and $\alpha_2 \neq 0$. The F-test (normal Wald test) is used for investigating long-run relationship.

The relationships between unemployment and output may not be correctly specified in the static linear, static asymmetric and dynamic linear regressions. (Silvapulle, Moosa, & Silvapulle, 2004) suggest that there are good reasons to believe the proposition that the output-unemployment relation as represented by Okun's law is asymmetric. Here, the meaning of

[12] Suppose $\Delta Y_{cyc,t-i}$ are zero and v_{t-1} is positive, this means that $U_{cyc,t-1}$ is too high to be in equilibrium, that is $U_{cyc,t-1}$ is above its equilibrium value. Since λ is expected to be negative, the term λv_{t-1}will be negative, therefore Δ $U_{cyc,t}$ is expected to be negative to restore the equilibrium. If $U_{cyc,t}$ is above its equilibrium value, it will start falling in the next period to correct the equilibrium error. If $v_{t-1}$is negative and $U_{cyc,t-1}$ is below its equilibrium value then λv_{t-1}will be positive, which will cause $\Delta U_{cyc,t}$ to be positive, leading $U_{cyc,t}$ to rise in period t.

asymmetry is that the response of unemployment to output growth is different when the economy is expanding from that when the economy is contracting.

c. NARDL model

The existing literature suggests that the unemployment-output relationship might be asymmetric ((Harris & Silverstone , 2001), (Altissimo & Violante, 2001), (Silvapulle, Moosa, & Silvapulle, 2004), (Marinkov & Geldenhuys, 2007), (Jardin & Stephan, 2010), (Shin, Yu, & Greenwood-Nimmo, 2014), and (Gouider, Nouira, & Sboui, 2018)). These papers shed new light on investigating the asymmetric relationship between the proposed variables.

The nonlinear autoregressive distributed lag (NARDL) model can be well-specified and can indicates the asymmetric nature of Okun's law.

The OLS estimator results in equation (2) will be poorly estimated in finite samples, and the hypothesis test cannot be carried out without removing the serial correlation and endogeneity in the regressors. Thus, we extend equation (2) into the following ARDL(p, q, q) model:

$$U_{cyc,t} = \sum_{j=0}^{q}(\theta_j^+ Y_{cyc,t-j}^+ + \theta_j^- Y_{cyc,t-j}^-) + \sum_{j=1}^{p} \delta_i U_{cyc,t-j} + \varepsilon_t \quad (5)$$

Where

$$U_{cyc,t-j} = B^j U_{cyc,t}, Y_{cyc,t-j}^+ = B^j Y_{cyc,t}^+, Y_{cyc,t-j}^- = B^j Y_{cyc,t}^-,$$

B is the lag operator, $\varepsilon_t \sim WN(0, \sigma^2)$, δ_i is the autoregressive parameter, θ_j^+ and θ_j^- are the asymmetric distributed-lagged parameters.

The popular time series approach for modeling and testing **asymmetries** in previous studies is the distributed lag model. The NARDL introduces the short run and long run **nonlinearities** in the positive and negative partial sum decompositions of the independent variable. The **error correction** model associated with the asymmetric cointegration form of equation (5) can be written as:[13]

$$\Delta U_{cyc,t} = [\rho u_{t-1}] + \sum_{j=0}^{p}(\beta_j^+ \Delta Y_{cyc,t-j}^+ + \beta_j^- \Delta Y_{cyc,t-j}^-) + \sum_{j=1}^{p-1} \pi_i \Delta U_{cyc,t-j} + \varepsilon_t \quad (6\text{-a})$$

which can be written alternatively as :

$$\Delta U_{cyc,t} = [\rho U_{cyc,t-1} + \theta^+ Y_{cyc,t-1}^+ + \theta^- Y_{cyc,t-1}^-] +$$

$$\sum_{j=0}^{p}(\beta_j^+ \Delta Y_{cyc,t-j}^+ + \beta_j^- \Delta Y_{cyc,t-j}^-) + \sum_{j=1}^{p-1} \pi_i \Delta U_{cyc,t-j} + \varepsilon_t, \quad (6\text{-b})$$

where

$$u_t = U_{cyc,t} - [\beta^+ Y_{cyc,t}^+ + \beta^- Y_{cyc,t}^-], \quad (6)$$

ρ, θ^+ and θ^- are the long run parameters, and π_j^+ and π_j^- are the short run parameters.

Shin et al. (2014) refer to Equation (6-b) as the NARDL model. The Okun's coefficients are the asymmetric long run parameters:

[13] It is easily seen in (Shin, Yu, & Greenwood-Nimmo, 2014) that either (6-a) or (6-b) is an equivalent transformation of an ARDL (p, q, q) model for $U_{cyc,t}$, $Y_{cyc,t}^+$ and $Y_{cyc,t}^-$ with q = p + 1.

$$\beta^{+} = \frac{-\theta^{+}}{\rho} \quad and \quad \beta^{+} = \frac{-\theta^{-}}{\rho}. \quad (7)$$

In order to observe the effects of the financial crisis and revolution effects, two dummy variables are created for the 2008 world financial crisis (GFC) and revolutions of 2011. If the date t is equal or greater than 2008, D_1 equals 1, otherwise $D_1 = 0$. Likewise, the dummy D_2 is set as 1 starting with 2011. The two dummy variables will be included in the above models (5) and (6-a) and (6-b) to examine the effects of the financial crisis and revolutions. The NARDL model can be estimated by the OLS and it is a valid model regardless of the integration orders of the regressors.

B. Cointegration and Asymmetric Relationship

a. Boud-Testing long run relationship

To further look into the nature of the unemployment-output tradeoff, we need to test whether the two indicators are cointegrated or not.[14] If $\rho = 0$, (6-a) reduces to the linear regression involving only first differences, thus implying that there is no longrun relationship between the levels of $U_{cyc,t}$, $Y^{+}_{cyc,t}$ and $Y^{-}_{cyc,t}$. We consider three testing procedures : with two of them are based on the error correction model (6-a).

(Banerjee, Dolado, & Mestre, 1998) propose the use of the t-statistic testing

$$H_0: \rho = 0 \quad (8\text{-a})$$

against $H_a: \rho < 0$, while Pesaran, Shin and Smith (2001) propose an F-test of the joint null,

$$H_0: \rho = \theta^{+} = \theta^{-} = 0 \quad (8\text{-b})$$

Against $H_a: \rho \neq 0 \cup \theta^{+} \neq 0 \cup \theta^{-} \neq 0$ in (6-a). These tests are based on statistics denoted t_{BDM} and F_{PSS} respectively by Shin et al. (2014). If the null could be rejected, based on the bounds testing approach (Pesaran et al (2001)), it suggests the existence **of long run asymmetric relationship**.

Following (Engle & Granger, 1987) (EG), the third test is a two-step residual-based approach proposed by Shin et al. (2014). The first stage involves the estimation of (2) by OLS, while in the second stage, one tests the resulting residuals for a unit root. They denote this t-statistic t_{EG}. The asymptotic distributions of these three statistics, t_{BDM}, F_{PSS} and t_{EG}, are all non-standard under their respective null hypotheses. The associated critical values of F_{PSS} and t_{BDM} statistics are available from (Pesaran, Shin, & Smith, 2001), while those of the t_{EG} statistic are recorded in (Hamilton, 1994).

b. Wald-Testing symmetry

In practice, four distinct cases may be identified as follows: an unrestricted specification, (6-a), accommodating asymmetries in both the short- and long-run and three restricted specifications obtained by imposing the short- and the long-run symmetry restrictions in (6-a), separately and

[14] Nonlinear asymmetric cointegration technique will be applied.

jointly.[15] Moreover, the long- and short-run symmetry restrictions can be easily tested. All the symmetry tests are based on the standard Wald tests.The **long run symmetries** can be examined by testing

$$H_0: \theta^+ = \theta^- \ (9)$$

While the **short run symmetries** can be examined by testing

$$H_0: \beta_j^+ = \beta_j^- \ \text{(for all j = 0, ..., q-1)},\ (10)$$

or

$$H_0: \sum_{j=0}^{q-1} \beta_j^+ = \sum_{j=0}^{q-1} \beta_j^- \ (11).$$

c. Dynamic multipliers

A useful tool for analysing both the asymmetric short run adjustment and the asymmetric long run reaction is the dynamic multipliers. These multipliers represent the transition between the initial equilibrium, short run disequilibrium after a shock, and the new long run equilibrium. Indeed, the asymmetric dynamic multiplier measure the effects of one unit change in $Y_{cyc,t}^+$ and $Y_{cyc,t}^-$ individually on $U_{cyc,t}$ and can be derived from equation (6-b). They are defined as:

$$m_h^+ = \sum_{j=0}^{h} \frac{\partial U_{cyc,t+j}}{\partial Y_{cyc,t}^+} \ and\ m_h^- = \sum_{j=0}^{h} \frac{\partial U_{cyc,t+j}}{\partial Y_{cyc,t}^-} \quad for\ h = 0, 1, 2 \ldots \qquad (12)$$

where $m_h^+ \rightarrow \beta^+$ and $m_h^- \rightarrow \beta^-$ if $h \rightarrow \infty$.

We calculate then the dynamic multipliers to obtain a measure of the cumulative effects of asymmetric output shocks on labour markets and thus, to depict the adjustments of labour markets in the disequilibrium unemployment-output relationship towards new long run equilibrium.

III. Empirical Results

In this section, we apply NARDL approach to modelling asymmetries to the simultaneous analysis of both long- and short-run nonlinearities in the relationship between output and unemployment in 6 MENA countries (Tunisia, Egypt, Morocco, Lebanon, Jordan, and Oman). Firstly, to establish a reference point, we estimate the static linear regression of unemployment on a constant, a dummy variables and output (Table B 5) and a static asymmetric model of the

[15] By imposing the long-run symmetry restrictions $\theta^+ = \theta^- = \theta$, (6-b) simplifies to :

$\Delta U_{cyc,t} = [\rho U_{cyc,t-1} + \theta Y_{cyc,t-1}] + \sum_{j=1}^{p-1} \pi_i \Delta U_{cyc,t-j} + \sum_{j=0}^{p} (\beta_j^+ \Delta Y_{cyc,t-j}^+ + \beta_j^- \Delta Y_{cyc,t-j}^-) + \varepsilon_t$ (6-c).

(6-c) has been employed by (Borenstein, Gregorio, & Lee, 1998) and (Apergis & Miller, 2006) to investigates the short-run dynamic asymmetries characterising respectively for the response of retail gasoline prices to fluctuations in the price of crude oil and for the wealth effects on consumption due to liquidity constraints. When imposing short-run symmetry restrictions, taking either of two forms: $\beta_j^+ = \beta_j^-$ (for all j = 0, ..., p) or $\sum_{j=0}^{p} \beta_j^+ = \sum_{j=0}^{p} \beta_j^-$ in the presence of an asymmetric long-run relationship, we obtain :

$\Delta U_{cyc,t} = [\rho U_{cyc,t-1} + \theta^+ Y_{cyc,t-1}^+ + \theta^- Y_{cyc,t-1}^-] + \sum_{j=1}^{p-1} \pi_i \Delta U_{cyc,t-j} + \sum_{j=0}^{p} \beta_j \ \Delta Y_{cyc,t-j} + \varepsilon_t$. (6-d)

Finally, the most restrictive specification is obtained when assuming linearity of the longrun relationship in conjunction with symmetric short-run adjustment:

$\Delta U_{cyc,t} = [\rho U_{cyc,t-1} + \theta Y_{cyc,t-1}] + \sum_{j=1}^{p-1} \pi_i \Delta U_{cyc,t-j} + \sum_{j=0}^{p} \beta_j \ \Delta Y_{cyc,t-j} + \varepsilon_t$ (6-e)

Clearly, (6-e), (6-d) and (6-c) are a special case of the most unrestricted specification described by (6-b).

form of equation (2), the results of which are reported in Table B 6. Then, if necessary the ECM model (Table B 10), and the ARDL approach (Table B 11 and) are also considered.

1. Data analysis and static models

Before going on the model specification, we have to analyse our data. Unemployment (U) and output (GDP) data are collected from World Databank from 2000 to 2014 (T = 15) for MENA zone (6 countries : Tunisia, Egypt, Morocco, Lebanon, Jordan, and Oman). By applying the (Hodrick & Prescott, 1997) filter (HP filter), output and unemployment variables are measured in terms of the cyclical components (time series are decomposed into trends and cycles). We convert annual (Low frequency) data to (Higher frequency) quarterly data by interpolation method. Hence we note respectively by $U_{cyc,t}$ and $Y_{cyc,t}$ the cyclical components of unemployment and output ($Y_{cyc,t}$ is the output gap), t = 1, …, 60. [16]

According to (Gujarati, 2003), before one pursues formal tests, it is always advisable to plot the time series under study. Such a plot (line graph of the level) and correlogram [of both the level (ACF) and the first difference (ACF and PACF)] gives an initial clue about the likely nature of the time series. From Figure 1 (for each variable) and Figure A 1 (correlogram of each variable), given in Apendice, unemployment may be stationnary for **Tunisia, Lebanon, and Jordan**. All other series may be not stationnary. Prior to our empirical analysis, we carried out augmented Dickey–Fuller (ADF), Phillips–Perron (PP), and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) unit root tests to examine whether the time-series of the variables follow stochastic trend. Table B 2 (in Appendice) reports the test results for both levels and first differences. The tests unambiguously suggest the existence of one unit root for every variable, indicating that the time-series are integrated of order 1, I(1) for Egypt, Moroccop, and Oman. We'll performe then Johansen's cointegration test on various variables to check for the existence of a long-run relationship for these countries.[17] Next, causality test à la Granger is applied. From Table B 3 and Table B 4 (in Appendice), we conclude:

_ one sided causality from output to unemployment for Tunisia, Egypt, Jordan, and Oman cases ($Y_{cyc,t} \rightarrow U_{cyc,t}$ and $U_{cyc,t} \not\rightarrow Y_{cyc,t}$),

_ bi-directional causality for the Morocco and Lebanon cases ($U_{cyc,t} \rightarrow Y_{cyc,t}$ **and** $Y_{cyc,t} \rightarrow U_{cyc,t}$).

From these results, we propose then

1_ to verify if Error correction models (ECM) are adequate for **Egypt, Morocco, and Oman** cases in order to consider both the short term and the long term possible relationship since both unemployment series and GDP series are **I(1)** for these countries.
2_ to tray otherwise an ARDL medel in first stage for all countries since this type of model is applied wether both serie are I(0), I(1), or if a combinaison of order of integrations is present.

3_ in a second stage, we tray to see if NARDL models are more appropriate.

[16] Data processing is done through software package Eviews 10.
[17] The unemployment hysteresis hypothesis implies that the unemployment rates are non-stationary. In econometric sense, Hysteresis theory is generally investigated by unit root test approaches.

All these propositions will be done in the next sub-sections. Prior to these investigations, we try some statistic models. By OLS, we estimate gap model in static specification (equation (1)). Results of point estimate are reported in Table B 5a nd Figure A 2 in Appendice. All Okun's coefficients estimated from static models are negative except for Oman (**1.070690**). Tunisia has the maximum in absolute value (**-81.49863**), while Jordan has the minimum in absolute value (-3.62). [18] There are several reasons why the link between unemployment and growth might change over time. Hence, it is necessary to analyze whether or not the link between unemployment and growth has been stable over time. A simple recursive estimation procedure is employed then for β. Figure A 3 depict okun coefficients estimated recursively for 2000 :1 to 2014 :4 (see Appendice). The link between unemployment and growth is unstable over time. Generally, the β declines for most of the countries (except for Egypt).

Now, output is decomposed as the partial sum processes of positive and negative growth rates. Results of estimation are reported in Table B 6 as well as a test for symmetry (see Appendice). In most cases the coefficient associated with a positive rate of growth of real GDP is of higher in absolute value than the parameter associated with a negative growth rates. Unfortunately, this outcome differs remarkably since there are some countries for which the opposite is true.

Again, it is necessary to analyze whether or not the link between unemployment and positive and negative growth rates has been stable over time. A simple recursive estimation procedure is then employed for β^+ and β^-. Figure A 4 depict okun coefficients estimated recursively for 2000 :1 to 2014 :4 (see Appendice). The link between unemployment and positive and negative growth rates is unstable over time. Generally, at the begining, the β^+ and β^- declines for most of the countries (except those for Lebanon and β^- for Egypt) and are recently more stable (from 2011 for Lebanon and Oman, from 2012 for Tunisia, from 2006 for Morocco, and from 2009 for Jordan).

In all cases, we find a pronounced negative association between output and unemployment (except for Oman), with the results of asymmetric analysis indicating strong non-linearity (the **Wald** tests reject the null of symmetry ($\beta^+ = \beta^-$) in Egypt, Morocco, and Lebanon cases. Hence, asymmetry of the relation seems not to be a solid empirical ground for policy advice. The hypothesis of labour market hysteresis is valid only for Morocco and Lebanon.[19] However, the validity of these results is questionable given the evidence of severe model mis-specification [DW statistics are near zero (<<2) for all considered cases, see Table B 5 and Table B 6; errors are then autocorrelated]. The remaining autocorrelations indicates that the equations are not correctly specified and dynamic specification will be then more appropriate.

1. ECM and ARDL models

To verify if an Error correction model is adequate for Egypt, Morocco, and Oman cases, we began by linear cointegration tests between unemployment ($U_{cyc,t}$) and output ($Y_{cyc,t}$).[20] Johansen tests results are given in Table B 9 in Appendice. Both λ_{trace} and λ_{max} test statistics

[18] This exercice is done with annual data for both gap model and first didfference model. Results are reported successively at Table B 7 and Table B 8 in Appendice. For both cases, DW statistics are near zero (<<2) and then the equations are not correctly specified.

[19] The theory of **labour market hysteresis** holds that the unemployment rate should react more strongly to recessions than to economic booms; that is $|\beta^+| < |\beta^-|$.

[20] The two main methods for testing co-integration are: Engle–Granger two-step method and Johansen test.

confirm cointegration between variables for the considered countries (**Egypt, Morocco, and Oman**) and thus long-run time-series relationship among the variables. In view of the presence of a cointegrating relationship among the variables, we specify then to see if an ECM is adequate for **Egypt, Marocco and Oman** series.[21] Table B 10 report ECM model results for both **Egypt and Oman** (see Appendice). [22] Both countries have **negative** Okun's cofficients. The maximum in absolute value is for Egypt (-24.508). Adjusment coefficients λ are negatif and significant. Two integrated series cannot cause each other in the long run unless they are cointegrated. Long run causality is then valid for both countries since λ is significant. By impulse response function (IRF), we can also judge those Error correction models (ECM). Figure A 5 (in Appendice) illustrate the response of unemployment to innovations and the response of GDPG to innovations (see Appendice). For the **Egypt** case (a), it is clear that an increase in GDP leads to less unemployment.

Since ARDL models are based on I(1) and/or I(0) variables, we check then if an ARDL model give more adequate results. These investigations (ARDL model applied to 6 MENA countries) are illustrated in Table B 11 and
Table B 12 simultaneously without and with consideration of structural change (see Appendice). These tables reports then estimation results for the restricted ARDL regression of the form of Equation (6-c) in which long- and short-run symmetry is imposed by assumption. By $\mathrm{F_{PSS}}$ test, cointegration between unemployment and GDP is validated for **Tunisia, Egypt, Lebanon, and Jordan** (statistic is bigger than upper boud). $\mathrm{F_{PSS}}$ test is not conclusive for Morocco (statistic between critical bound value). While for Oman F_{PSS} test reject **linear** cointegration (see Table B 11 in Appendice). The estimated long-run coefficients for **Egypt, Lebanon, and Jordan** are **-26.40685,** -6.759308, and -6.188457 respectively (3.7%, 14.79%, 16.16%). Long-run coefficient is not significant for **Tunisi**a due to the failure to accurately model the long-run relationship. These results change if we take account of possible structural change in unemployment series. From
Table B 12 (in Appendice), we note that cointegration is validated now for **Tunisia, Lebanon, Jordan, and Oman.** While for Egypt and Morocco, $\mathrm{F_{PSS}}$ tests are not conclusive (statistic is between critical bound value).[23] All long-run coefficients are negative except Oman's coefficient (1.06). **Tunisian** long-run **coefficient is till not significant**. Negative and significant coefficients are then between -4.6 and -6.6 (for **Jordan and Lebanon** successively).[24] Most of these results are in line with (Moosa I. A., 2008)'s finding. With an ARDL model applied to 4 MENA coutries : Tunisia, Algeria, Morocco, and Egypt (and with annual observations covering the period 1990-2005), Moosa show that Okun's coefficient is not significant in any case. But, long run coefficients are larger than the previous findings in magnitude ((Moosa I. A., 2008), (Kreishan, 2011), and (Andari & Bouaziz, 2015)). **For all these ARDL models,** cyclical upturns and downturns have symmetrical effects on unemployment.

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[21] Results for Morocco are not reported since adjustement coefficient λ is not significant.

[22] Optimal lag length for both cases is 6 (AIC creteria is used for selection).

[23] By AIC creteria, optimal lags (p and q) are selected for each country: ARDL(3, 2) for Tunisia,, ARDL(2, 0) for Lebanon, ARDL(3, 1) for Jordan, and ARDL(2, 1) for Oman.

[24] All these models are well specified since errors behave as WN (except for Oman, wich errors are still correlated). It is necessary to analyze whether or not the link between employment and growth has been stable over time. We can't give a conclusion about stability of proposed models. Models are possibly stable since QUSUM and QUSUM of square of recursive stability tests give not the same conclusion, see Figure A 6 given in Appendice. However, for Liban, ARDL model is till not stable.

2. NARDL models

To observe the impacts of positive and negative output shocks separately, we'll analyze the asymmetries of the unemployment-output tradeoff by NARDL specifications. Again, optimal lags are selected by AIC creteria. Then specified model for each countries are given in Table 1. Non linear cointegration is validated by F_{PSS} test for **all countries** in 5% level (except for Morocco in 10% level). **Long-run** symmetric hypotheses are rejected for all countries (except for **Oman**) by **Wald test** (Table 1). It means that the responsiveness of unemployment to cyclical output shocks in these countries are asymmetric in the long run. Again, all significant long-run coefficients are negative except for Oman. For **Libanon and Jordan**, only cyclical downturns ($Y^{-}_{cyc,t}$) have significant effect. The estimated long-run coefficients on $Y^{-}_{cyc,t}$ is equal to -6.946339 for Lebanon and -6.961538 for Jordan. It means that shocks in the recessionary regime are considerably more persistent than those in the expansionary regime.[25] For **Lebanon and Jordan**, this suggests that an economic **downturn** of about 14.3% increases unemployment by 1%. While for **Egypt**, only cyclical upturns ($Y^{+}_{cyc,t}$) have significant effect. It means that shocks in the expansionary regime are considerably more persistent than those in the recessionary regime. The estimated long-run coefficients on $Y^{+}_{cyc,t}$ is equal to **-40.00420** which suggest for Egypt that an economic **upturn** of about 2.5% decrease unemployment by 1%.

Both cyclical **upturns and downturns** have been identified (are significant effects) for **Tunisia, Morocco, and Oman**.[26] The estimated long-run coefficients on $Y^{+}_{cyc,t}$ and $Y^{-}_{cyc,t}$ are -29.62463 and -19.87014 for Tunisia, -33.51304 and -41.15086 for Morocco, and 1.540225 and 1.043388 for Oman, respectively. Therefore, we may conclude that in **Tunisia** an economic upturn of just **3.37%** reduces unemployment by **1%**, while the downturn of 5.03% in the economy increases unemployment by 1%. In **Morocco**, we may conclude that an economic upturn of 2.98% is necessary to reduce unemployment by 1% while an economic downturn of 2.43% achieves the opposite.[27] These results differ from previous studies for Tunisia. The results with an **ECM** model and quarterly data from **1990 :1 to 2014** :1, given by Andari and Bouaziz (2015), show that an increase of **1%** of GDP above the critical value (mean of output growth) in the long term would lead to a **1.4%** decline in the unemployment rate in Tunisia. For Gouider, Nouira, and Sboui (2018), with an **NARDL gap** model (based on HP filter) **and annual data** from **1980 to 2015** for Tunisian economy, if real GPG decrease by 1% , unemployment increase by 1,02%. But, an expension of 1% leads to a decrease of unemployment by 0,85%.

Again, the hypothesis of labour market hysteresis is valid only for Morocco, Lebanon and Jordan ; the unemployment rate react more strongly to recessions than to economic booms : $|\beta^{+}| < |\beta^{-}|$.[28]

[25] This indicates that the labour markets in **Lebanon and Jordan** quickly respond to the economic downturn. The employers speedily lay off employees in order to cut costs during recession, howbeit, they are slow to hire. This is explained as the hysteresis in the labour market.

[26] Further evidence of the rejection of long-run linearity is provided by the case of Tunisia.

[27] The associated values for Oman are 64.93% and 95.8%.

[28] Hysteresis theory indicates that if there **is rigidity** in labor market, cyclical fluctuations will have permanent effect on the level of unemployment rate.

Table 1 : NARDL estimation results.

	Tunisia	**Egypt**	**Morocco**	**Lebanon**	**Jordan**	**Oman**
Models	NARDL(3, 3, 1)	NARDL(2, 0, 2)	NARDL(2, 2, 2)	NARDL(2, 0, 0)	NARDL(3, 1, 1)	NARDL(2, 1, 0)
Dummies	D2008	D2011		D2008	D2004	D2008
Non linear cointegration test						
F_{PSS} statistic	15.34976	7.798279	3.125158	14.19732	12.25269	4.650494
Cointegration	**YES**	**YES**	**No conclusion***	**YES**	**YES**	**YES**
ECT_{t-1}	**-0.296457**	**-0.217030**	**-0.247310**	**-0.418251**	**-0.518710**	**-0.218676**
LR coefficients						
$Y^{+}_{cyc,t}$	**-29.62463**	**-40.00420**	**-33.51304**	**2.651388***	**-1.681989***	**1.540225**
$Y^{-}_{cyc,t}$	**-19.87014**	**-12.09941***	**-41.15086**	**-6.946339**	**-6.961538**	**1.043388**
Difference	-9.75449	-27.90479	7.637820	9.597727	5.279549	0.496837
Symmetric Wald tests (p-value)						
W_{LR}	0.0000	0.0000	0.0007	0.0000	0.0000	**0.2669**
W_{SR}	0.0222	**0.0814**	**0.1423**		**0.0910**	0.0023
W_{Sr1}	0.0454	**0.0786**	**0.2302**			
W_{Sr2}	0.0000	0.0279	0.0013			
W_{Sr3}	0.0000					
Conclusion	**LR asym SR asym**	**LR asym SR asym**	**LR asym SR asym**	**LR asym**	**LR asym SR sym**	**LR sym SR asym**
Diagnostic						
R^2	0.902246	0.990428	0.938771	0.967839	0.910620	0.965600
LM (p-value)	0.3648	0.8861	0.0518	0.4294	0.6867	0.5216
ARCH (pvalue)	0.8300	0.7189	0.6874	0.9802	0.9193	0.9077

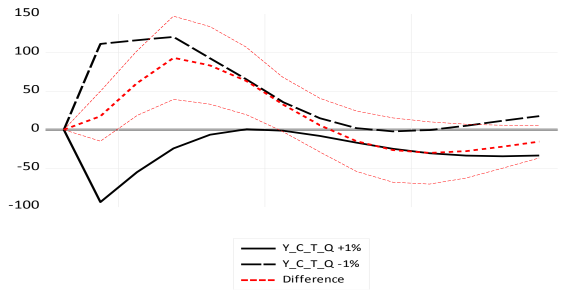
Note: For (Pesaran, Shin, & Smith, 2001) bounds test, critical values given by Eviews are **3.1** and **3.87** for 5% level and **2.63** and **3.35** for 10% level. P_value is given hor LM and ARCH tests. * : for Morocco, cointegration is valid only at 10% level. * : $Y^{+}_{cyc,t}$ *and/or* $Y^{-}_{cyc,t}$ is not significant. W_{LR} is for long run hypothesis H_0: $\theta^{+} = \theta^{-}$. W_{SR} is for short run hypothesis H_0: $\sum_{j=0}^{q-1} \pi_j^{+} = \sum_{j=0}^{q-1} \pi_j^{-}$. W_{Srj} is for individual short run hypothesis H_0: $\pi_j^{+} = \pi_j^{-}$, j=1, 2, 3.

In Table 1, regardless of the model specifications, only 3 countries receive significant shocks from the 2008 world financial crisis (*Tunisia, Libanon, and Oman*). When the output fluctuates, the disequilibrium relationship between unemployment and output can be gradually calibrated over time by the adjustment of asymmetries in the dynamic nonlinear model. Also, only Egypt who has received a significant shock from 2011 « Yasamin revolution ».

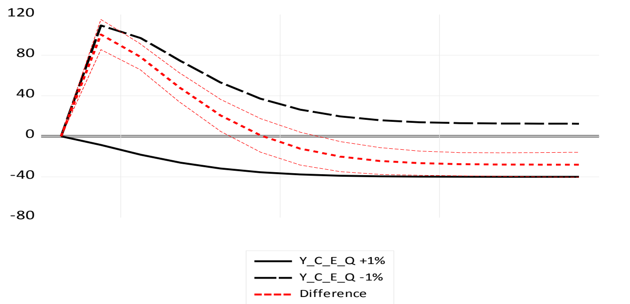
Turning now to the analysis of **short-run** dynamic non-linearity, we find that the **Wald test** cannot reject the null of (weak-form) **summative symmetric** adjustment in Egypt, Morocco and Jordan. But that it is rejected at the 10% level in Jordan and Egypt and at 5% level in **Tunisia** and **Oman**. However, our confidence in the power of this test is limited, particularly given the apparent asymmetry in the patterns of the dynamic multipliers presented in panels (b) and (e) (Egypt and Jordan) of Figure 2.[29]

The **dynamic multipliers** for each country (Figure 2) provide interesting insights into the nature of both the long- and short-run asymmetries characterising the unemployment output relationship. The dynamic multiplier represents also the adjustments of unemployment-output tradeoff from its initial equilibrium to the new equilibrium over time. It is associated **with unit**

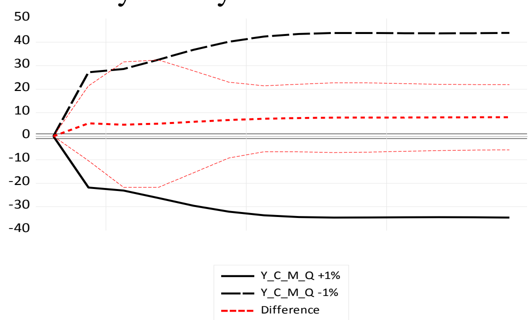
[29] Individual short-run symmetric hypotheses are rejected for all countries except for Jordan.



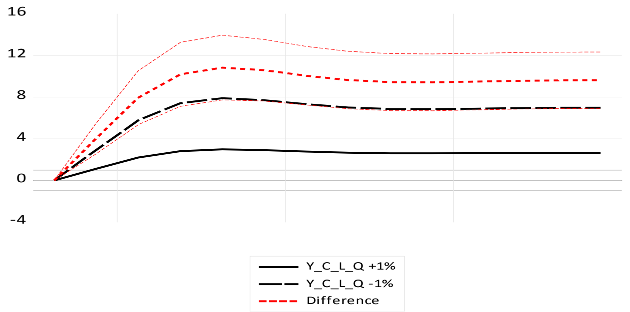
(a) Tunisia : SR asymmetry & LR symmetry



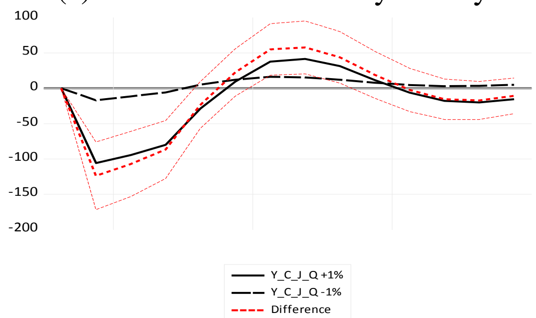
(b) Egypt: LR & SR asymmetry



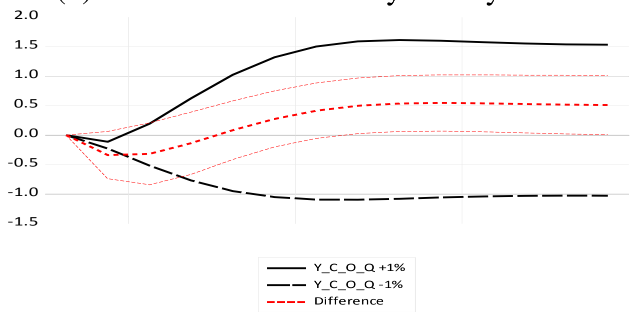
(c) Morocco: LR & SR symmetry



(d) Libanon : LR & SR asymmetry



(e) Jordan : LR symmetry & SR asymmetry



(f) Oman : LR & SR asymmetry

Figure 2: The unemployment-output tradeoff dynamic multipliers.

changes in $Y^{+}_{cyc,t}$ and $Y^{-}_{cyc,t}$ on $U_{cyc,t}$, respectively. Figure 2 presents the asymmetric dynamic multipliers for the MENA erea economies. The black continue curves are for positive changes while discontinue black curves are for negative changes. Red curves are for the difference with its confidence intervals. As the **dynamic multipliers** demonstrate, the labour markets respond rapidly and powerfully to cyclical slump of outputs in the **short run** (1-4 quarters) in Tunisia, Egypt, Marocco, and Jordan. The unemployment-output relationship is symmetric only in Morocco. Tunisia, Egypt and Jordan demonstrate the existence of asymmetric effects in the unemployment-output tradeoff, which are either dominated by a positive output shock (for Jordan) or negative output shock (for Tunisia and Egypt). In the case of **Tunisia and Egypt (Jordan)**, the results indicate that the labour market responds rapidly and strongly to cyclical **downturns** (upturns) in the very short-run. But, that full adjustment to the new equilibrium is a relatively **prolonged process** for Egypt and Tunisia while it is a **rapid** process for Jordan.[30] The labour markets exhibit relatively rapid adjustment in the first year with the absolute effect

[30] Models are stable since QUSUM and QUSUM of square of recursive stability tests give the same conclusion, see Figure A 7 given in Appendice.

of an economic **contraction** being significantly **larger** than that of an expansion in Tunisia, Egypt, Morocco, and Libanon. The opposite is true for Jordan and Oman; absolute effect of an economic expansion is significantly **larger** than that of **contraction**. Following this initial period, the speed of adjustment **slows** in Tunisia, Egypt, Morocco, Libanon, and Oman cases. To compare magnitude of cofficients given by different models, we sum up all results in Figure 3. Table 2 and Figure 3 The empirical results from all models do not indicate robust evidence but it confirm an inverse linkage between unemployment rate and economic growth, as the Okun's Law suggests.

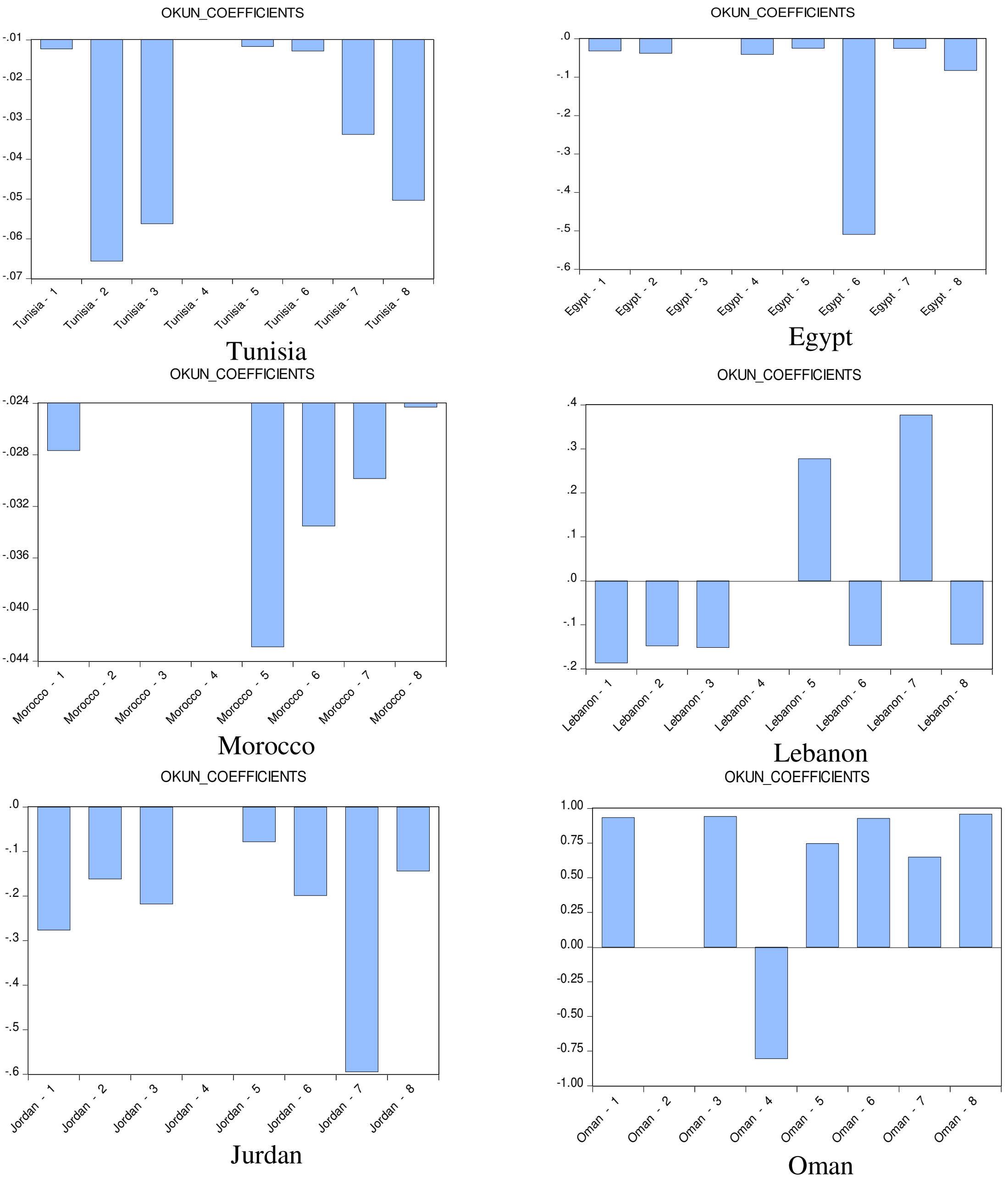


Figure 3 : Okun's coefficients by each method and for each country [**1 Static model, 2 ARDL model, 3 ARDL with shift, 4 ECM, 5 (+) and 6 (-) Static with asymmetric effects, 7 (+) and 8 (-) NARDL model**].

Table 2 : Sum up of estimated coefficient results and inverse of Okun coefficient (second line)

Models/country	Tunisia[31]	Egypt [32]	Morocco*	Lebanon	Jordan[33]	Oman
1 Static (Eq1)	-81.49863 **-0,01227014**	-31.41883 **-0,03182805**	-36.13966 **-0,02767043**	-5.355558 **-0,18672191**	-3.620438 **-0,27620967**	1.070690 **0,93397715**
2 ARDL	-15.242731 -0,06560504	-26.4068 -0,03786903	—	-6.75930 -0,14794431	-6.18845 -0,16159135	—
3 ARDL2	-17.78981 -0,05621196	—	—	-6.597560 -0,15157119	-4.588806 -0,21792161	1.061708 0,94187856
4 ECM	—	-24.50812 **-0,0408028**	—	—	—	-1.242773 **-0,80465218**
Static asy (Eq2)						
$5(+)\ Y^{+}_{cyc,t}$	-85.91988 -0,01163875	-40.44182 -0,02472688	-23.31527 -0,04289035	3.601260 0,27768059	-12.80593 -0,07808882	1.338943 0,74685778
$6(-)\ Y^{-}_{cyc,t}$	-78.12264 -0,01280039	-1.963509* -0,50929229	-29.83251 -0,03352048	-6.803833 -0,14697598	-5.027716** -0,19889747	1.077606 0,92798295
NARDL $7(+)\ Y^{+}_{cyc,t}$	**-29.62463** -0,0337557	**-40.00420** -0,02499738	**-33.51304** -0,02983913	**2.651388** 0,37716094	**-1.681989** -0,59453421	**1.540225** 0,64925579
NARDL $8(-)\ Y^{-}_{cyc,t}$	**-19.87014** -0,05032677	**-12.09941** -0,08264866	**-41.15086** -0,02430083	**-6.946339** -0,14396073	**-6.961538** -0,14364642	**1.043388** 0,95841624

Note : ARDL2 is for ARDL with dummy variables. * : for Marocco, cointegration is valid at 10% level. [1 Static, 2 ARDL, 3 ARDL with shift, 4 ECM, 5 (+) and 6 (-) Static with asymmetric effects, 7 (+) and 8 (-) NARDL].

IV. Conclusion

Many studies introduced the idea of the possible asymmetry of the relationship between economic growth and the change in the rate of unemployment ((Lee, 2000); (Virén, 2001)). In fact, they consider that expansions and contractions in output could not have the same absolute effect on unemployment which implies that Okun's coefficient might be different over the business cycle. The Okun's law has been considered as useful in forecasting and policy-making.

This study has investigated the asymmetric unemployment-output tradeoff in the MENAzone (6 countries : Tunisia, Egypt, Morocco, Lebanon, Jordan, and Oman) from 2000 to 2014 using the NARDL approach for Okun's Law in the **gap model where** variables are measured in terms

[31] With an ARDL model applied to 4 MENA coutries : Tunisia, Algeria, Morocco, and Egypt (and with annual observations covering the period 1990-2005), (Moosa I. A., 2008) show that Okun's coefficient is **not significant** in any case. The following Table resume (Moosa I. A., 2008)'s results (Eq5 : structural time serie, Eq3 : ARDL model, and Eq3 : static model) :

Okun's coefficient	Tunisia	Egypt	Morocco
Eq5	-0.062	-0.024	0.16666
Eq3	-0.024	0.005	0.015
Eq 2	-0.056	-0.079	0.102

[32] (Moosa I. A., 2008) found that Okun's coefficient is 0.005 in Egypt during the period 1975-2005. While, using the Error Correction Mechanism, (Elshamy, 2013) found -0.021 for the period 1970-2010.

[33] (Al-hosban, 2017) found that Okun's coefficient is – 0.004 in the period 1982-2016 in Jordanian economy by an ECM model. For (Alamro & Al-dalaien, 2014), unemployment rate is weakly affected by the growth rate during the period (1980-2011): when the Jordanian economy rise with 1% rate the unemployment rate will drop by 0.007%.

of the cyclical components. Annual data are also converted to quarterly frequency. Analysis and data processing is done through software package Stata 15 and Eviews 10.

Initially, the static linear, static asymmetric, and dynamic linear models (ARDL) fail to explain the long run tradeoff between unemployment and output due to severe model misspecifications. Most of these results are in line with (Moosa I. A., 2008)'s finding. But, long run coefficients are larger than the previous findings in magnitude ((Moosa I. A., 2008), (Kreishan, 2011), (Elshamy, 2013) , (Alamro & Al-dalaien, 2014), (Andari & Bouaziz, 2015), and (Al-hosban, 2017)).

The NARDL estimates conclude that a long run relationship between unemployment and output exists in the 6 MENAzone economies, where 5 of them suffer from asymmetric effects. Long run unemployment-output correlation is found to be asymmetric in all MENA zone except Oman in which short run unemployment-output correlation is found to be asymmetric. Only in Tunisia, both long run and short run unemployment-output correlation are found to be asymmetric. In **Tunisia** an economic **upturn** of just 3.37% reduces unemployment by 1%, while the **downturn** of 5.03% in the economy increases unemployment by 1%. For **Morocco**, we may conclude that an economic **upturn** of 2.98% is necessary to reduce unemployment by 1% while an economic **downturn** of 2.43% achieves the opposite. For both **Lebanon and Jordan**, an economic **downturn** of about 14.3% increases unemployment by 1%. While for **Egypt**, an economic **upturn** of about 2.5% decrease unemployment by 1%.

Empirical finding provides then an additional proof that Okun's law could exist in a developing countries such as Tunisia, Egypt, Morocco, Lebanon, and Jordan (except Oman).

The crucial question now is how economic policy can influence these links in favor of a more job-intensive growth. Unemployment can be controlled to a certain limit, depending on the types and the causes of the unemployment in each country. Note that, the lack of employment opportunities for the young, first time job-seekers in these countries arises from a host of other factors, including: the skill mismatch, a high reservation wage, and limited labor mobility.

The study recommended job creation by investing in productive sectors and to design educational programs that match with labor market needs. Also, any attempt to increase GDP through some economic fiscal and/or monetary policies would reduce unemployment rate.

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Appendice

Empirical Review

Table B 1 : A breif empirical review.

References	**Idea/methods**	**Region**	**Results**	**Asymmetry**
(Okun A. M., 1962)	Okun's law: inverse unemployment-output relationship			NO
(Moosa I. A., 1997)	Linear model		measure the cost of unemployment	NO
(Lee, 2000)	robustness of the unemployment-output correlation	16 OECD countries	asymmetric effects and structural breaks	YES
(Harris & Silverstone , 2001)	asymmetric approach	New Zealand.	long run and short run correlation between unemployment and output are asymmetric	YES
(Schorderet Y. , 2001)	nonlinear long run asymmetric regression			YES
(Altissimo & Violante, 2001)	nonlinear VAR model.	US economy	asymmetries in the shocks	YES
(Harris & Silverstone , 2001)	Okun's law, asymmetric approach	OECD countries	short run adjustment of labour markets to the disequilibrium	YES

			during the downturn of the conomic cycle.[34]	
(Granger & Yoon, 2002)	hidden cointegration	USA	lack of robust evidence of linear cointegration	NO
(Keller & Nabil, 2002)	responsiveness of employment to GDP growth	eight MENA countries	improving the region's labour market outcomes can be achieved by improving the growth prospects	NO
(Sögner & Stiassny, 2002)	regime-switching approach and Bayesian and Kalman filtering	15 OECD economies	structural instability is caused by the labour demand or supply shocks	NO
(Gardner, 2003)	validity of Okun's law	MENA countries	There are public sector and labour market rigidities	NO
(Silvapulle, Moosa, & Silvapulle, 2004)	Okun's law, and asymmetric dynamic model	US postwar economy	Asymmetric unemployment-output correlation	YES
(Perman & Tavera, 2005)		Europe	convergence of the Okun's coefficient in the short and medium run.	NO
(Huang & Lin, 2006)	nonlinear inference approach	US sample	nonlinear unemployment-output relationship	NO
(Moosa I. A., 2008)	ARDL	Algeria, Egypt, Morocco and Tunisia	Okun's law is not valid for the four countries.	NO
(Jardin & Stephan, 2010)	asymmetric unemployment-output tradeoff	Europe	unemployment reacts to output strongly when the economy is in a downswing	YES
(Kreishan, 2011)	cointegration	Jordan	Okun's law cannot be confirmed for Jordan	NO
(Zanin & Marra, 2012)	penalized regression spline approach	Eurozone economies	inverse correlation is spatially heterogeneous and time-varying	NO
(Hutengs & Stadtmann, 2013)	age effect	Eurozone	output shock leads to an asymmetric digestion and effect	YES
(Shin, Yu, & Greenwood-Nimmo, 2014)	nonlinear asymmetric cointegration technique	USA, Canada, and Japan	Absolute effect of an economic contraction being significantly larger than that of an expansion.[35]	YES

[34] (except Canada), while the existence of long run relationship between unemployment and output has been rejected in the US and New Zealand.
[35] Following initial period, the speed of adjustment slows in both cases, but remains somewhat more rapid in the recessionary case.

(Andari & Bouaziz, 2015)	ECM	Tunisia	Okun's law holds with an ECM specification and an Okun's coefficient less than required	NO
(Gouider, Nouira, & Sboui, 2018)	Non linear model	Tunisia	unemployment is more sensitive to cyclical downturns	YES

Tables

Table B 2: Unit root tests and stationary test results.[36]

		Level		1st difference		Conclusion	
Countries	**variables**	$U_{cyc,t}$	$Y_{cyc,t}$	$U_{cyc,t}$	**GDP**	$U_{cyc,t}$	$Y_{cyc,t}$
Tunisia	**ADF** **PP** **KPSS**	0.0182 0.0103 0.126056	0.0952 0.2047 0.529555	0.0131 0.0000	0.1002 0.0001	I(0)	I(1)
Egypt	**ADF** **PP** **KPSS**	0.0108 0.1015 0.328493	0.0014 0.4643 0.362314	0.1374 0.0001	0.2203 0.0167	I(1)	I(1)
Morocco	**ADF** **PP** **KPSS**	0.9850 0.9665 0.811827	0.9605 0.5183 0.663375	0.7182 0.0000	0.4235 0.0000	I(1)	I(1)
Lebanon	**ADF** **PP** **KPSS**	0.0215 0.0729 0.119007	0.0570 0.4153 0.247811	0.0002 0.0002	0.0301 0.0291	I(0)	I(1)
Jordan	**ADF** **PP** **KPSS**	0.0364 0.0204 0.198781	0.0350 0.6271 0.739772	0.0036 0.0000	0.0614 0.0729	I(0)	I(1)
Oman	**ADF** **PP** **KPSS**	0.1577 0.3227 0.324576	0.1423 0.2417 0.221434	0.0218 0.0001	0.0190 0.0001	I(1)	I(1)

Note : Asymptotic critical values for KPSS test is 0.463 for 5% level ; see Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1). Stationary hypothesis is rejected if LM statistic is greater than 0.463. P-value are reported for PP and ADF tests. Empirical static is reported for KPSS test.

Table B 3: Granger non causality test results for I(1) variables.

Countries	**Egypt**		**Morocco**		**Oman**	
Hypothesis	**Statistic (p-value)**		**Statistic (p-value)**	**Conclusion**	**Statistic (p-value)**	**Conclusion**
H0 : $\boldsymbol{Y_{cyc,t}}$ **does not Granger Cause** $\boldsymbol{U_{cyc,t}}$	2.03965 (0.0920)	$Y_{cyc,t}$→$U_{cyc,t}$**	7.80945 (3.E-05)	$Y_{cyc,t}$→$U_{cyc,t}$	2.38672 (0.0537)	$Y_{cyc,t}$→$U_{cyc,t}$**
H0 : $\boldsymbol{U_{cyc,t}}$ **does not Granger**	1.95823 (0.1044)	$U_{cyc,t}$-/→$Y_{cyc,t}$	8.63004 (1.E-05)	$U_{cyc,t}$→$Y_{cyc,t}$	0.53873 (0.7458)	$U_{cyc,t}$-/→$Y_{cyc,t}$

[36] The Augmented Dickey-Fuller (ADF) which is known by the unit root test and Phillips Perron (PP) are used to test non stationarity in our sample.

Cause $Y_{cyc,t}$			

Note : ** and * significant respectively at 10% and 5% level. → mean cause. Considered VAR models are in first difference. Lag length choice is based on information creteria (equal 5 for all cases).

Table B 4: Granger non causality test results for mixed variables.

Countries	**Tunisia**		**Libanon**		**Jordan**	
Hypothesis	**Statistic (p-value)**	**Conclusion**	**Statistic (p-value)**	**Conclusion**	**Statistic (p-value)**	**Conclusion**
H0 : $Y_{cyc,t}$ does not Granger Cause $U_{cyc,t}$	4.74194 (0.0015)	$Y_{cyc,t}$→$U_{cyc,t}$**	3.27451 (0.0136)	$Y_{cyc,t}$→$U_{cyc,t}$	4.43247 (0.0024)	$Y_{cyc,t}$→$U_{cyc,t}$**
H0 : $U_{cyc,t}$ does not Granger Cause $Y_{cyc,t}$	0.37780 (0.8612)	$U_{cyc,t}$-/→$Y_{cyc,t}$	2.71937 (0.0320)	$U_{cyc,t}$→$Y_{cyc,t}$	0.93364 (0.4689)	$U_{cyc,t}$-/→$Y_{cyc,t}$

Note : ** and * significant respectively at 10% and 5% level. → mean cause. Lag length choice is based on information creteria (equal 5 for all cases). Only non stationnary serie is differenced in the VAR representation.

Table B 5: Static Linear Regression (Equation (1)).

	Tunisia	**Egypt**	**Marocco**	**Lebanon**	**Jordan**	**Oman**
$Y_{cyc,t}$	**-81.49863**	**-31.41883**	**-36.13966**	**-5.279392**	**-3.620438**	**1.070690**
Constant	0.359314	-0.028244	0.110892	0.188955	-0.159855	-0.005675
D2011	-2.375468					
D2009				-0.379423		
D2008		0.266789		-0.380870		-0.028447
D2004					-1.490914	
k	-0.01227	-0.031828	-0.02767	-0.18942	-0.27621	0.933977
Diagnostic						
DW	**0.454455**	**0.178814**	**0.325072**	**0.291352**	**0.317870**	**0.359125**
R²	0.527753	0.756821	0.665445	0.778879	0.555693	0.782244

Note : DW is the Durbin Watson statstic. D2004=1 for 2004 and zero otherwise. D2008=1 for observations from 2008 till 2014 and zero otherwise. D2011=1 for observation from 2011 till 2014 and D2011=0 if not. D2009=1 for 2009 and zero otherwise. In all cases, R^2 > DW ; all these regressions seams to be spurious.

Table B 6: Static Asymmetric Regression (Equation (2)).

Variables	**Tunisia**	**Egypt**	**Morocco**	**Lebanon**	**Jordan**	**Oman**
$Y^{+}_{cyc,t}$	**-85.91988**	**-40.44182**	**-23.31527**	**3.601260**	**-12.80593**	**1.338943**
$Y^{-}_{cyc,t}$	**-78.12264**	**-1.963509***	**-29.83251**	**-6.803833**	**-5.027716****	**1.077606**
D2004					-1.439706	
D2008		0.930593		-1.404995		-0.045947
D2011	-1.969444	1.679278				
_cons	0.586460	0.141402*		0.036390*	-0.081444*	-0.013541
Statistics						
F	21.31557	64.90977		162.6603	24.22167	72.72475
Wald(p-value)	0.3345	**0.00000**	**0.0000**	**0.0000**	0.1929	0.0323
N	59					
R²	0.537608	0.827828	0.738886	0.898707	0.569185	0.798663
DW	**0.400019**	**0.265039**	**0.353201**	**0.853406**	**0.319245**	**0.401954**

legend: * are non significant; ** are significant in 10% level. D2004=1 for 2004 and zero otherwise. D2008=1 for observations from 2008 till 2014 and zero otherwise. D2011=1 for observation from 2011 till 2014 and D2011=0 if not. In all cases, R^2 > DW ; all these regressions seams to be spurious also**.**

Table B 7: Static gap model with annual Data.

Variable	Tunisia	Egypt	Morocco	Lebanon	Jordan	Oman
$Y_{cyc,t}$	-61.737447***	-48.08396***	-29.771834**	-6.165769***	-7.3954771	1.0764845***
D2011	-2.5068231***	-1.2694791*				
D2008		.53014197*	.1831366	-.44376612**	-.05421242	-.0284102*
OKun coefficient	-.01619762	-.02079696	-.03358879	-.16218577	-.13521778	.92894974
_cons	.34535795*	.10010515	.05612521	.19519526	-.31900128	-.00569278
F	27.856334	31.763337	11.079187	30.99123	1.3647729	18.487653
N	15	15	15	15	15	15
R^2	.87975349	.86542026	.72702779	.75774773	.1485098	.79246356
DW						

legend: * p<0.05; ** p<0.01; *** p<0.001

Table B 8: Static first difference model with annual data.

Variable	Tunisia	Egypt	Morocco	Lebanon	Jordan	Oman
GDPG	-.81139624*	-.51779747***	-.1978918*	.05337575	-.10331683	.00409135
D2008	-1.1978158	.88657434	.43010899	.28287835	-.42330297	-.05752443
D2011		-1.6824155*			.25067428	
_cons	3.4573331*	2.3228089***	.45878518	-.29209849	.41493407	-.04613144
F	5.4363856	8.5993417	4.9149374	1.2891703	2.0127417	1.6605655
N	14	14	14	14	14	14
R^2	.55296815	.79133751	.47926802	.20252768	.45008339	.25960515
DW						

legend: * p<0.05; ** p<0.01; *** p<0.001

Table B 9: Linear cointegration test results.

Countries			**Johansen statistics**			
	Hypothesis	λ_{trace}	p-value	λ_{max}	p-value	Conclusion
Egypt	**H₀ :** r=0 (None)	17.50355	0.0246	14.19046	0.0514	
	H₀ : r≤1 (At most1)	3.313094	0.0687	3.313094	0.0687	**yes**
Marocco	**H₀ :** r=0 (None)	16.09614	0.0406	15.60940	0.0305	
	H₀ : r≤1 (At most1)	0.486737	0.4854	0.486737	0.4854	**yes**
Oman	**H₀ :** r=0 (None)	15.80298	0.0449	13.52775	0.0651	
	H₀ : r≤1 (At most1)	2.275226	0.1315	2.275226	0.1315	**yes**

Notes : MacKinnon-Haug-Michelis (1999) p-values.

Table B 10: ECM estimation results.

	Egypt	**Oman**
	Cointegrating Equation	
$Y_{cyc,t-1}$	**-24.50812[-1.69801]**	**-1.242773 [-9.35393]**
Constant	-0.099995	0.020982
	Error Correction Model	
λ	**-0.096353[-2.81825]**	**-0.188743 [-2.41234]**
$\Delta U_{cyc,t-1}$	0.417570[2.00785]	**0.696733** [4.93610]
$\Delta U_{cyc,t-4}$		**-0.609686**[-4.79320]
$\Delta U_{cyc,t-5}$		**0.458102**[3.22557]

C		0.003549[2.17596]
D2008		-0.005654 [-2.15623]
$\Delta Y_{cyc,t-4}$	57.33586[2.63830]	
$\Delta Y_{cyc,t-5}$	**-75.12199[-3.62891]**	
Okun	-0.0408	-0.80465
Diagnostic		
R^2	0.740667	0.696415

Note : [] is the Student t statistic. Only significant results (5% or 10% level) are reported. Choice of the lag length is based on Akaike Information Criterion (AIC), Schwarz Criterion (SC) and Bayesian Information Criterion (BIC). Optimal lag is equal to 5 for both case.

Table B 11: ARDL models without shift.

Variable	**Tunisia**	**Egypt**	**Morocco**	**Lebanon**	**Jordan**	**Oman**
Models	ARDL(2, 2)	ARDL(2, 2)	ARDL(2, 2)	ARDL(2, 0)	ARDL(3, 1)	
F_{PSS}	8.722	6.362	5.408	7.151	11.005	3.133
Conclusion	**YES**	**YES**	**No conclusion***	**YES**	**YES**	**NO**
$\boldsymbol{\beta_0}$	-15.242731	**-26.40685*** **		-6.759308***	-6.188457**	
k	-0.065605	**-0.037869**		-0.147944	-0.1615912	
N	56	56		56	56	
R^2	.87044172	**.7917827**		.48332294	.47986244	
DW	2.206762	2.223593		2.218988	2.023205	

Note: For Pesaran, Shin, and Smith (2001) bounds test, Kripfganz and Schneider (2018) critical values are **5.065** and **5.964** for 5% level or **4.096** and **4.901** for 10% level. * p<.1; ** p<.05; *** p<.01. * : For Morocco, cointegration is valid at 10% level.

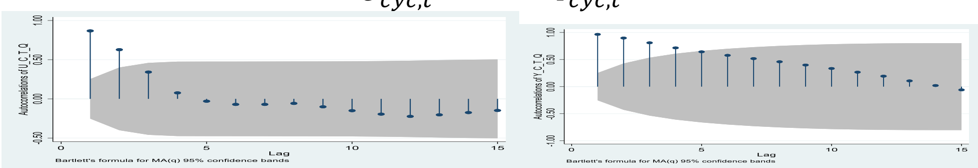
Table B 12: ARDL models with shift.

	Tunisia	**Egypt**	**Morocco**	**Lebanon**	**Jordan**	**Oman**
Models	ARDL(3, 2)	ARDL(2, 2)	ARDL(2, 2)	ARDL(2, 0)	ARDL(3, 1)	ARDL(2, 1)
Dymmy	D2008	D2011	D2008	D2008	D2004	D2008
Non linear cointegration test						
F_{PSS}	7.479941	3.987680	3.915407	9.088730	11.19294	5.224809
Conclusion	**YES**	**No conclusion***	**No conclusion***	**YES**	**YES**	**YES**
$\boldsymbol{\beta_0}$	-27.96465*			**-6.597560**	**-4.588806**	1.061708
k	-0.035759			**-0.151571**	**-0.2179216**	0.941879
Diagnostic						
LM	0.6171			0.3795	0.0309	0.3865
ARCH	0.6810			0.7082	0.7610	0.7600

Note: For Pesaran, Shin, and Smith (2001) bounds test, critical values given by Eviews are **3.62** and **4.16** for 5% level and **3.02** and **3.51** for 10% level. P_value is given hor LM and ARCH tests. * : for Egypt and Morocco, cointegration is valid at 10% level. * : $\boldsymbol{\beta_0}$ is not significant for Tunisia.

Figures

$U_{cyc,t}$ $Y_{cyc,t}$



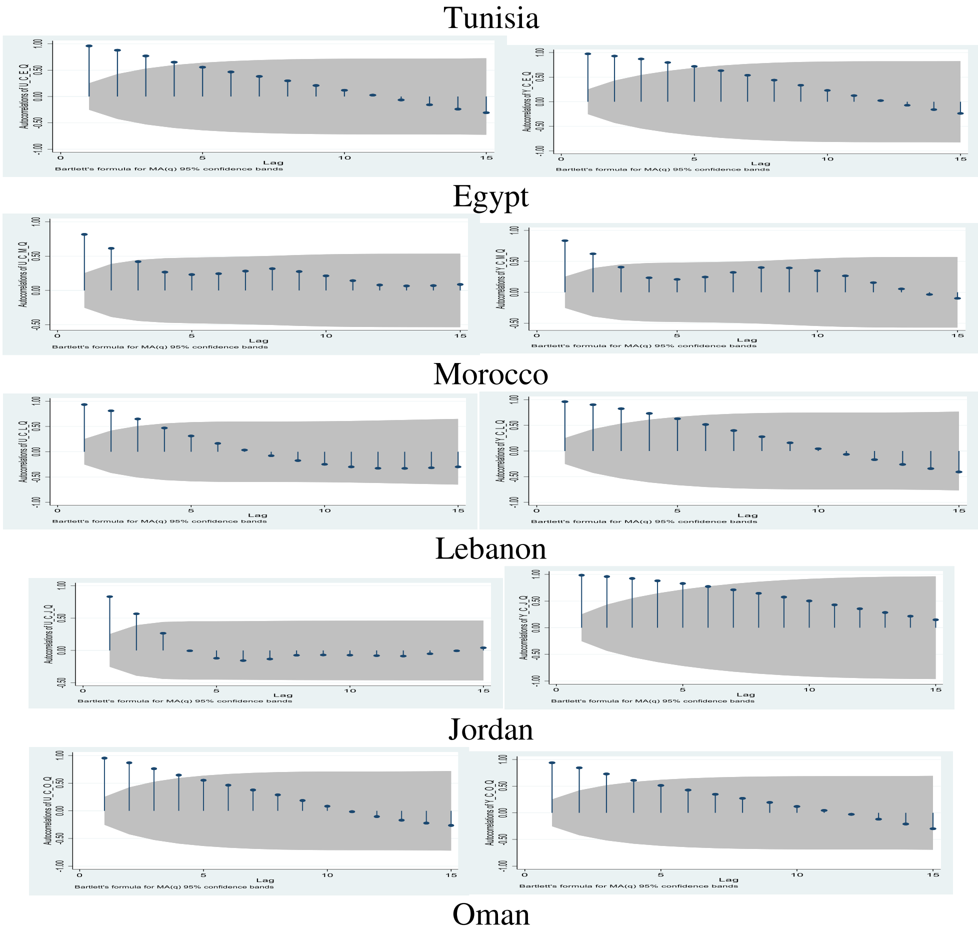


Figure *A 1* : Correlograms for each serie.

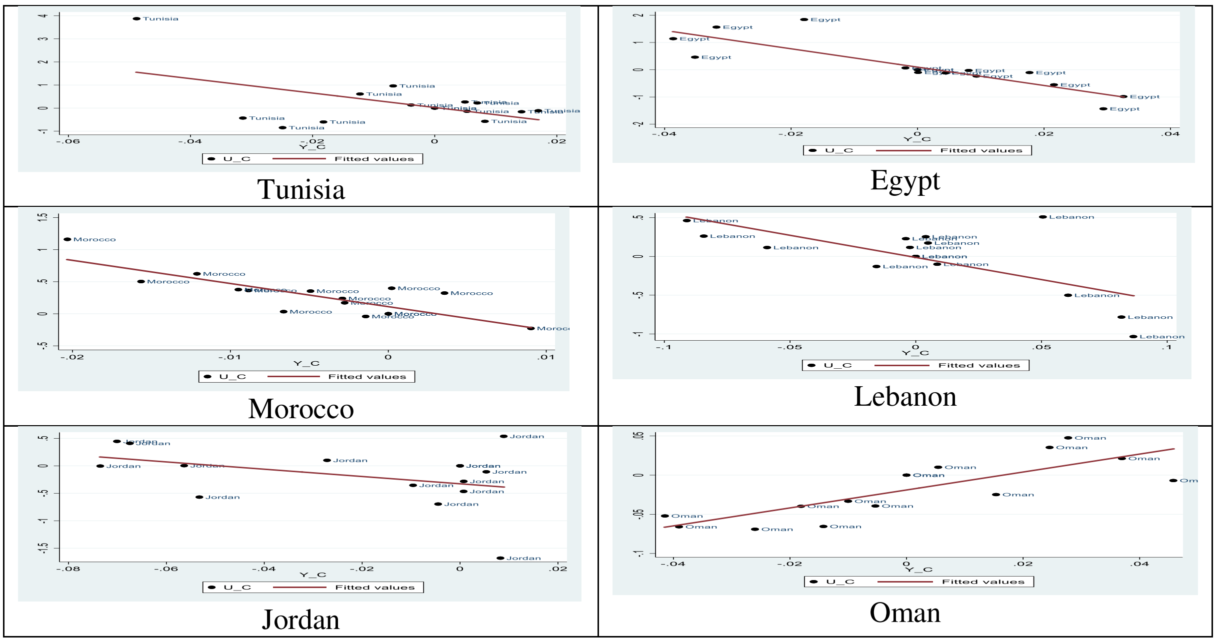
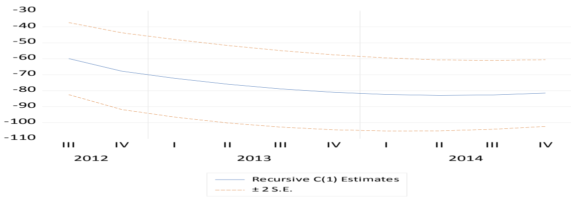
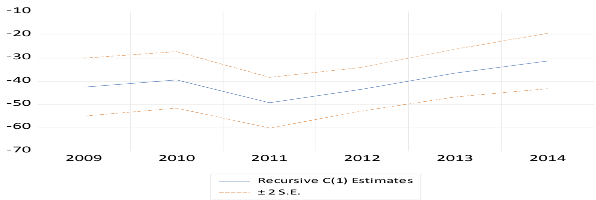


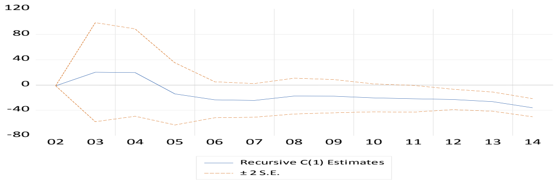
Figure *A 2*: Static regression with annual data.



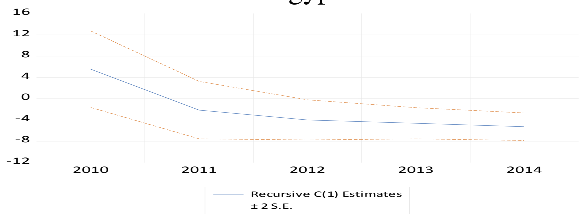
Tunisia



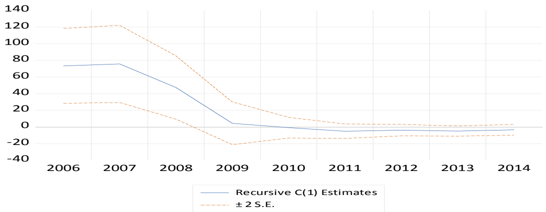
Egypt



Morocco



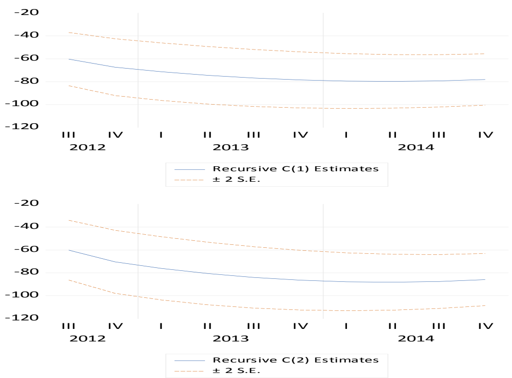
Libanon



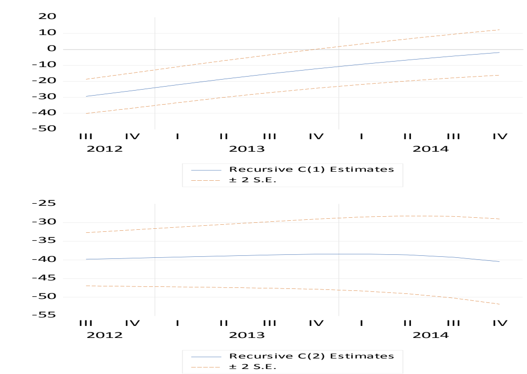
Jordan

Oman

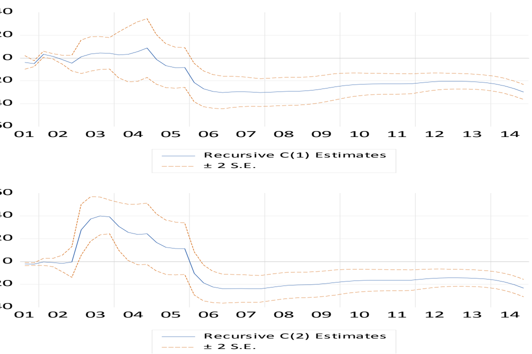
Figure A 3: Time Varying of β for MENA Countries 2000 :1-2014 :4.



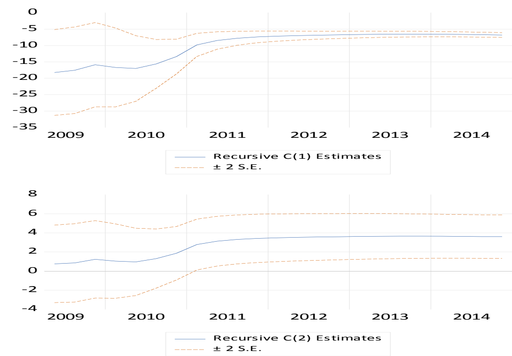
Tunisia



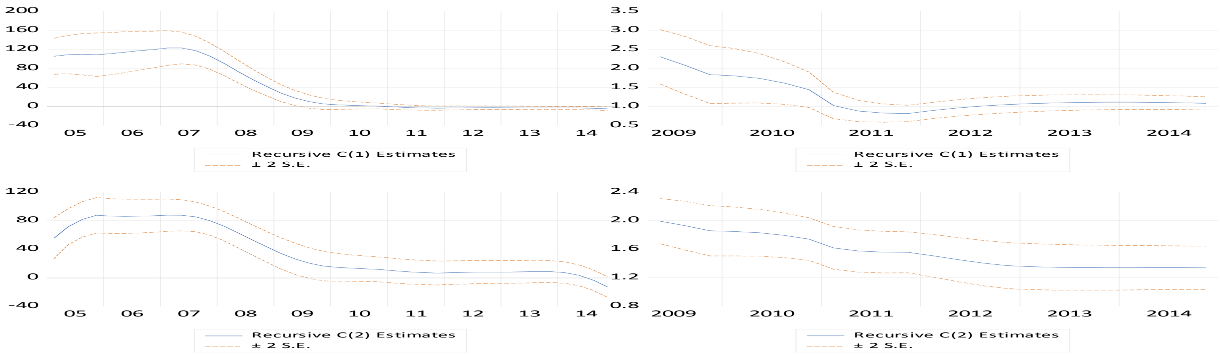
Egypt



Morocco

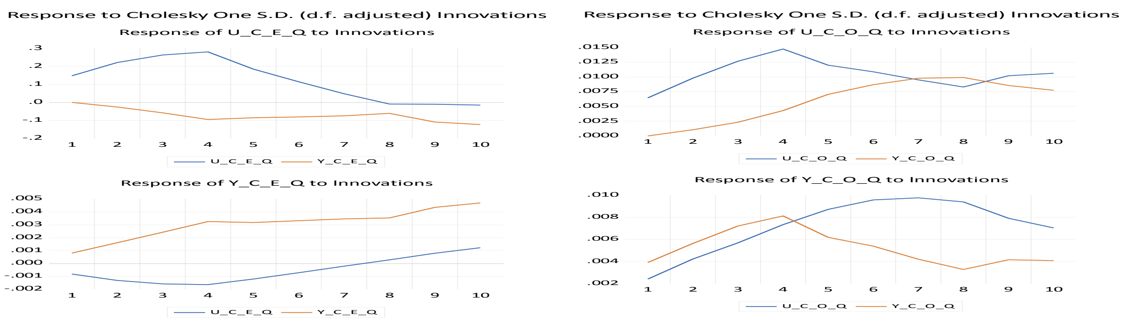


Lebanon



Jordan Oman

Figure A 4: Time Varying of $\beta^{-}$and β^{+} for MENA Countries 2000 :1-2014 :4.



(a) Egypt (b) Oman

Figure A 5: Impulse Response Functions.

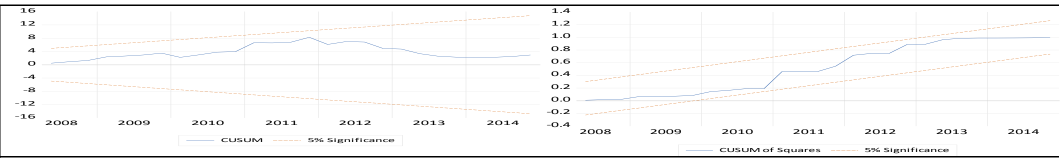
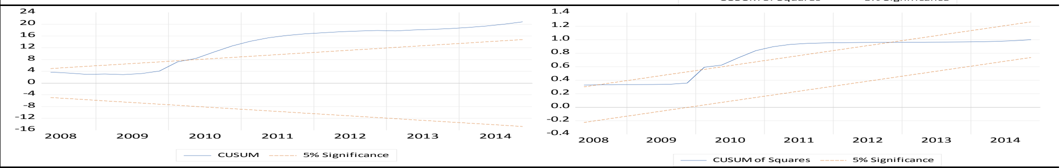
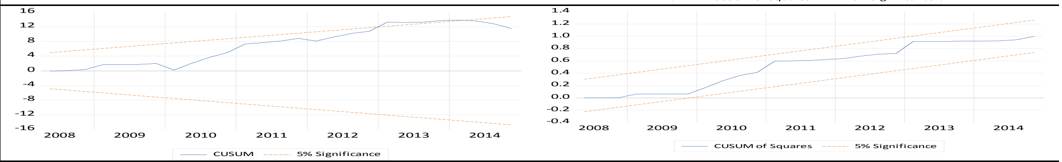
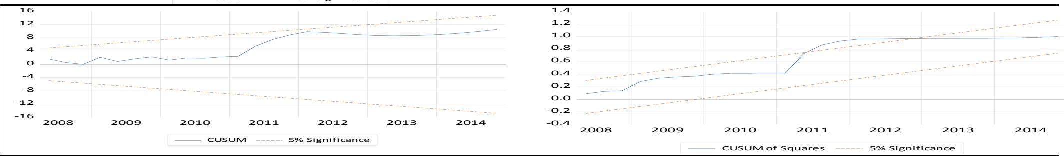
Tunisia	
Lebanon	
Jordan	
Oman	

Figure A 6: QUSUM and QUSUM of SQUARE tests for recursive stability for ARDL models.

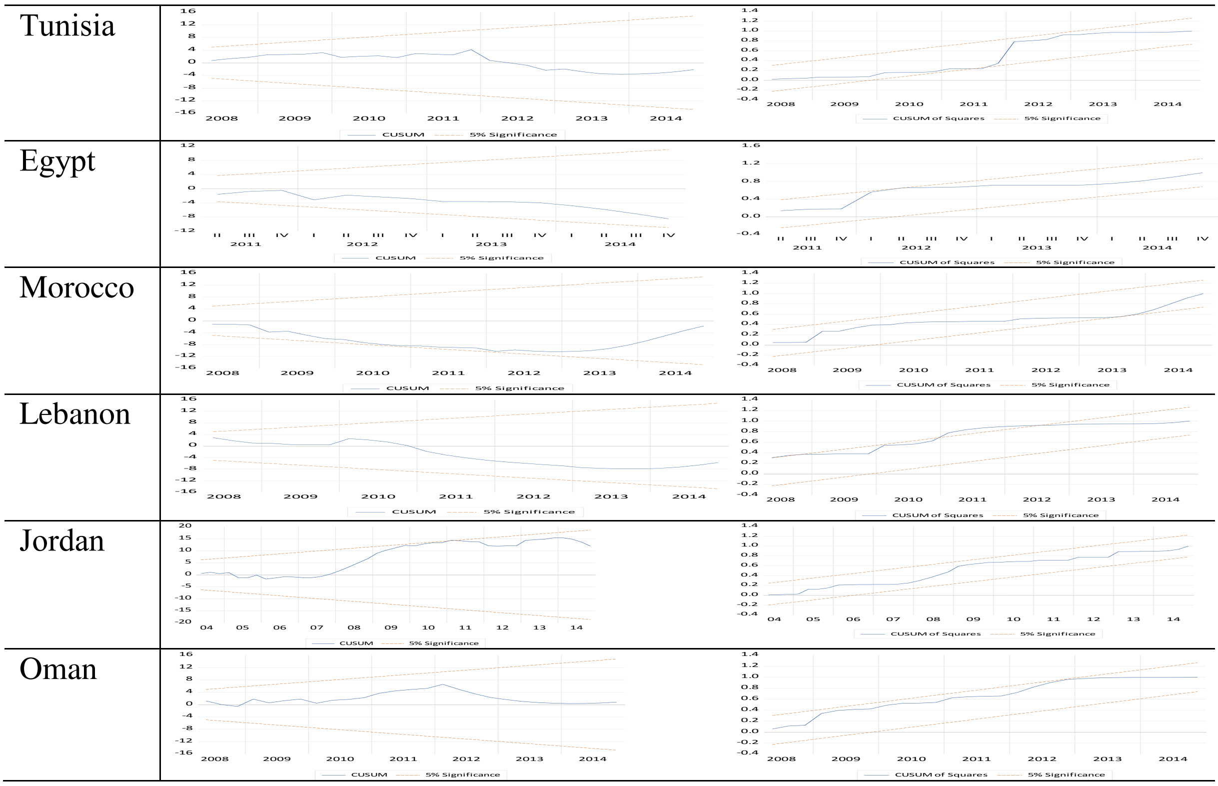


Figure A 7: QUSUM and QUSUM of Square recursive stability tests for NARDL models.